

Under the Small Tank Precipitation alternative, additional mixed LLW would be produced as a result of processing the precipitate. In a section of the Small Tank Precipitation facility, the precipitate slurry would undergo acid hydrolysis to separate it into a low-radioactivity organic portion (benzene) and a high-radioactivity aqueous portion. The organic portion would then be separated from the aqueous portion, washed to reduce the level of cesium, and transferred to the Organic Waste Storage Tank in S Area, which has a storage capacity of 150,000 gallons. A maximum of 60,000 gallons per year of benzene waste could be produced. DOE is investigating treatment and disposal options for this waste stream. This waste would be treated by incineration in the Consolidated Incineration Facility, in a portable vendor-operated incinerator or in a suitable offsite incineration facility, followed by disposal in a permitted facility. DOE analyzed the impacts of incineration in the Final Supplemental Environmental Impact Statement, Defense Waste Processing Facility (DOE 1994).

L1-11

Under the Solvent Extraction alternative, additional mixed LLW would be produced as a result of solvent replacement. The total solvent inventory for the process, consisting primarily of the diluent Isopar[®]L, is a projected 1,000 gallons. Using the conservative assumption that the solvent inventory is replaced once per year, a total of 13,000 gallons of organic solvent could be accumulated over the 13-year operating life. DOE is investigating treatment and disposal options for this waste stream similar to those discussed in the previous paragraph for benzene.

L1-11

Industrial waste

Under each of the action alternatives, DOE would expect to generate approximately 30 metric tons per year of industrial (nonhazardous, nonradioactive) waste as a result of startup activities and an additional 20 metric tons per year during operations. The projected volume represents less than 1 percent

of the forecasted SRS industrial waste generation through 2029 (Halverson 1999). This waste would be recovered for recycling or disposed of onsite at the Three Rivers Landfill (DOE 2000d).

Sanitary waste

Sanitary wastewater from the salt processing facilities would be treated in the Centralized Sanitary Wastewater Treatment Facility and discharged to Fourmile Branch via NPDES outfall G-10. These discharges would be expected to comply with current NPDES permit limitations.

Under each of the action alternatives, DOE would expect to generate approximately 62 metric tons per year of solid sanitary wastes as a result of startup activities and an additional 41 metric tons per year during operations. The projected volume represents about 5 percent of the forecasted SRS sanitary waste generation through 2029 (Halverson 1999). This waste would be disposed of onsite at the Three Rivers landfill (DOE 2000d).

4.1.12 UTILITIES AND ENERGY

This section discusses potential utility and energy impacts from construction and operation under each of the salt processing alternatives. The scope of the analysis includes electric power, fuel (diesel and gasoline) consumption, process water consumption, and steam use. DOE used applicable past SRS operations or engineering to estimate the energy and utility requirements of the alternatives. Estimates of water use include: process additions, cooling, and flushing; product washes; and grout production. Steam is used primarily to operate the ventilation systems and to heat waste solutions during processing. Fuel consumption is based on use of diesel-powered equipment during construction activities and diesel emergency power generators. The analysis compared the use of electricity, water, and steam to the available capacities discussed in Section 3.10.

DOE would obtain utilities and energy from existing sources and suppliers. Water would come from existing site wells; and electricity and fuel

would come from existing on- and offsite suppliers. Steam would be produced onsite.

Table 4-20 lists electric energy, fuel, steam, and water use during the construction and

operation phases of each action alternative. Overall, DOE does not expect substantial increases in water use or energy consumption with implementation of any of the alternatives, including No Action.

Table 4-20. Estimated project total energy and utilities use for the salt processing alternatives.

Phase ^a	SRS Baseline ^b	Small Tank Precipitation	Ion Exchange	Solvent Extraction	Direct Disposal in Grout
<i>Potable water use (million gallons)</i>					
Construction	NA	19	20	19	18
Operation	NA	99	95	120	75
Project subtotal					
use	NA	118	115	139	93
<i>Process water use (million gallons)</i>					
Construction	NA	16	17	16	15
Operation	23,000 ^c	301	271	225	181
Project subtotal					
use	NA	317	288	241	196
Project total water use (million gal- lons)	NA	435	403	380	289
<i>Peak electrical power demand (megawatts)</i>					
Construction	NA	1.66	1.66	1.66	1.66
Operation	130 ^c	24	24	32	18
<i>Electricity use (gigawatt-hours)</i>					
Construction	NA	76	79	76	73
Operation	410 ^c	243	286	315	172
Project total use	NA	319	365	391	245
<i>Steam use (million pounds)</i>					
Construction	NA	0	0	0	0
Operation	NA	2,548	2,300	1,915	1,536
Project total use	NA	2,548	2,300	1,915	1,536
<i>Fuel use (million gallons)</i>					
Construction	NA	8.4	9	8.4	8
Operation	8.75 ^d	0.3	0.3	0.3	0.2
Project total use	NA	8.7	9.3	8.7	8.2

Adapted from WSRC (1999e).

a. From Table 2-1, the construction and operation duration of each alternative are as follows: Small Tank Precipitation – 48 months and 13 years; Ion Exchange – 50 months and 13 years; Solvent Extraction – 48 months and 13 years; and Direct Disposal in Grout – 46 months and 13 years. The total project duration includes a startup duration of 1.3 years for each alternative (Sessions 1999).

b. Construction of any new tanks would require approximately 660,000 gallons of water and 45,000 gallons of fuel per tank. Utility and energy use under the No Action alternative would be similar to use at the existing HLW Tank Farms, and is included in the baseline.

c. Halverson (1999).

d. DOE (1995).

NA = Not Available.

4.1.12.1 Water Use

During the approximately 4-year construction phase, the estimated demand for water would range from 33 to 37 million gallons, depending on the processing alternative selected. On a daily average basis, the highest use would represent about 2.3 percent of water used in H-, S-, and Z-Area facilities in 1998 (SCDHEC 1999a) and 0.2 percent of the lowest estimated production capacity of the aquifer (16 million gallons per day) (WSRC 1998b).

Under the No Action alternative, construction of any new tanks would require approximately 660,000 gallons of water per tank (DOE 1980), which is less than 0.1 percent of the aquifer production capacity.

During the 13-year operational phase, total water use for the action alternatives would be similar and would vary between 256 and 400 million gallons, depending on the processing alternative selected. On a daily average use basis, the highest use would be about 22.6 percent of the volume used in H-, S-, and Z-Area facilities during 1998 (SCDHEC 1999a), and 1.5 percent of the lowest estimated production capacity of the aquifer (WSRC 1998b).

Water use for the entire duration of the project would be similar for all action alternatives and would be between 289 and 435 million gallons, for the Direct Disposal in Grout and Small Tank Precipitation alternatives, respectively.

For the No Action alternative, water use during operation under any scenario would be slightly higher than the existing HLW Tank Farms and would therefore constitute a slight increase over the baseline.

4.1.12.2 Electricity Use

During construction, the estimated peak electrical power demand would be 1.7 megawatts for each alternative, with use varying between about 73 and 79 gigawatt-

hours, depending on the processing alternative selected. The peak power demand would be a small fraction of the H-Area power distribution network's capacity (64 megawatts) (WSRC 1996). Power for S and Z Areas would be supplied through the H-Area network.

Electric power demand during construction of any tanks under the No Action alternative would be similar to that of the action alternatives.

During operations, the peak electric power demand would be very similar for each action alternative and would vary between 18 and 32 megawatts, depending on the processing alternative selected. In combination with the 22-megawatt demand for power from H-Area facilities, a total demand of 54 megawatts is possible, which represents 84 percent of the H-Area power distribution network's capacity (WSRC 1996). The highest peak power demands and electricity use would occur under the Solvent Extraction alternative. Electricity use during operations would be similar for each action alternative and would vary between 172 and 315 gigawatt-hours, depending on the alternative selected.

Electricity use for the entire duration of the project would be between 245 and 391 gigawatt-hours, for the Direct Disposal in Grout and Solvent Extraction alternatives, respectively.

For the No Action alternative, electric power demand during operation of any scenario would be slightly higher than the existing HLW Tank Farms and would therefore constitute a slight increase over the baseline.

4.1.12.3 Steam Use

No steam would be used during the construction phase for any of the alternatives, including No Action. The main uses for steam during the operation phase would be operation of building ventilation systems and waste solution heating. Operation of the ventilation systems would account for most of the steam used. Total steam use during the operations phase would be similar under each alternative and would range from 1.5 to 2.5 billion pounds for the Direct Disposal in

Grout and Small Tank Precipitation alternatives, respectively. On a daily average use basis, the highest use would be about 18.3 percent of the steam used in H-, S-, and Z-Area facilities, and 1.5 percent of the steam production capacity for H-, S-, and Z-Area facilities (WSRC 1996).

Steam use under the No Action alternative would be slightly higher than current use rates at the existing HLW Tank Farms. Therefore, the No Action alternative would constitute a slight increase over the baseline.

4.1.12.4 Fuel Use

Diesel and gasoline fuels would be used during the construction and operation phases of the project, primarily for the operation of mobile heavy equipment and stationary support equipment. Fuel consumption would be similar under all the action alternatives. The highest consumption of liquid fuels, about 9 million gallons, would be during the construction phase of the Ion Exchange alternative (2.1 million gallons per year). Liquid fuel use during the operations phase of any alternative is low, at less than 300,000 gallons total. As a comparison, operations at SRS used approximately 8.75 million gallons of liquid fuels in 1994 (DOE 1995).

Under the No Action alternative, a total of approximately 45,000 gallons of diesel fuel and gasoline would be required per tank during construction (DOE 1980). Liquid fuel use during the operation phase would be similar to the existing Tank Farm and is included in the baseline.

4.1.13 ACCIDENT ANALYSIS

This section summarizes risks to the public and workers from potential accidents associated with the various salt processing action alternatives at SRS.

Detailed descriptions of each accident, including the scenario description, probability of occurring, radiological source terms, non-radiological hazardous chemical release

rates, and consequences are provided in Appendix B.

An accident is a sequence of one or more unplanned events with potential outcomes that endanger the health and safety of workers and the public. An accident can involve a combined release of energy and hazardous materials (radiological or chemical) that might cause prompt or latent health effects. The sequence usually begins with an initiating event, such as human error, equipment failure, or earthquake, followed by a succession of other events that could be dependent or independent of the initial event, which dictate the accident's progression and the extent of materials released. Initiating events fall into three categories:

- *Internal initiators* normally originate in and around the facility, but are always a result of facility operations. Examples include equipment or structural failures and human errors.
- *External initiators* are independent of facility operations and normally originate outside the facility. Some external initiators affect the ability of the facility to maintain its confinement of hazardous materials because of potential structural damage. Examples include aircraft crashes, vehicle crashes, nearby explosions, and toxic chemical releases at nearby facilities that affect worker performance.
- *Natural phenomena initiators* are natural occurrences that are independent of facility operations and occurrences at nearby facilities or operations. Examples include earthquakes, high winds, floods, lightning, and snow. Although natural phenomena initiators are independent of external facilities, their occurrence can involve those facilities and compound the progression of the accident.

Because current operations are the basis from which each of the proposed alternatives begins, the hazards associated with each of the action alternatives are in addition to those of current operations. However, after the period of opera-

tion, the hazards associated with salt processing are eliminated and those associated with the storage of salt solutions would be substantially reduced. Because the No Action alternative includes primarily current operations that have been evaluated under the NEPA process and in approved safety analysis reports, accidents associated with current tank space management operations are not evaluated here. Failure of a Salt Solution Hold Tank is addressed in the High-Level Waste Tank Closure Draft EIS (DOE 2000e). The radiological and nonradiological hazards associated with the four action alternatives were evaluated in this section and Appendix B.

Nonradiological

The long-term health consequences of human exposure to nonradiological hazardous materials are not as well understood as those related to radiation exposure. Therefore, the consequences from accidents involving hazardous materials are expressed in terms of airborne concentrations at various distances from the accident location, rather than in terms of specific health effects.

Table 4-21 summarizes the impacts of accidents involving the release of nonradiological hazardous materials to the MEI and noninvolved workers. In general, impacts to these receptors resulting from accidents involving nonradiological hazardous materials are minimal. However, noninvolved workers exposed to atmospheric releases of benzene from two of the accidents evaluated under the Small Tank Precipitation alternative could develop serious or life-threatening health effects. Workers exposed to airborne benzene concentrations (950 mg/m^3) resulting from an Organic Waste Storage Tank (OWST) loss of confinement accident could experience serious health effects that may impair their ability to take protective action (e.g., dizziness, confusion, impaired vision). Workers exposed to airborne benzene concentrations ($8,840 \text{ mg/m}^3$) resulting from an explosion in the OWST, could experience life-threatening health effects (e.g., loss of

consciousness, cardiac dysrhythmia, respiratory failure). Both of these accidents would occur less than once in 100,000 years and are in the extremely unlikely category.

Radiological

Tables 4-22 through 4-25 summarize for each salt processing alternative the estimated impacts to onsite workers and the public from potential accidents involving the release of radiological materials. These tables list potential accident consequences for all receptors as LCFs per accident and LCFs per year. The LCF per accident values are an estimate of the consequences without accounting for the probability of the accident occurring. The LCF per year values do take the accident's probability into consideration and provide a common basis for comparison of accident consequences.

DOE estimated impacts to five receptors: (1) the MEI at the SRS boundary; (2) the offsite population in an area within 50 miles (80 kilometers); (3) an involved worker 328 feet (100 meters) from the accident; (4) a noninvolved worker 2,100 feet (640 meters) from the accident location, as discussed in DOE (1994); and (5) the onsite population (includes both involved and noninvolved workers).

For all of the accidents, there is a potential for injury or death to involved workers in the vicinity of the accident. In some cases, the impacts to the involved worker would be greater than to the noninvolved worker. DOE estimated the increased probability of an LCF to an involved and a noninvolved worker from radiation exposure during each of the accident scenarios.

However, prediction of latent potential health effects becomes increasingly difficult to quantify with any certainty as the distance between the accident location and the receptor decreases, because the individual worker exposure cannot be precisely defined with respect to the presence of shielding and other protective features. The involved worker may be acutely injured or killed by physical effects of the accident itself. DOE identified potential accidents in Cappucci et al.

Table 4-21. Estimated consequences of accidents involving nonradioactive hazardous materials.

	Small Tank Precipitation	Ion Exchange	Solvent Extraction	Direct Disposal in Grout
Accidents Involving Sodium Hydroxide Releases				
Caustic Feed Tank Loss of Confinement – Frequency:	Once in 30 years			
MEI Dose (mg/m ³)	5.9×10^{-4}	5.9×10^{-4}	5.9×10^{-4}	5.9×10^{-4}
Noninvolved Worker (640 m) Dose (mg/m ³)	0.18	0.18	0.18	0.18
Caustic Dilution Tank Loss of Confinement – Frequency:	Once in 30 years			
MEI Dose (mg/m ³)	NA	NA	NA	0.0031
Noninvolved Worker (640 m) Dose (mg/m ³)	NA	NA	NA	0.93 ^a
Accidents Involving Nitric Acid Releases				
Nitric Acid Feed Tank Loss of Confinement – Frequency:	Once in 30 years			
MEI Dose (mg/m ³)	NA	NA	8.8×10^{-5}	NA
Noninvolved Worker (640 m) Dose (mg/m ³)	NA	NA	0.026	NA
Accidents Involving Benzene Releases				
PHA Surge Tank Loss of Confinement – Frequency:	Once in 30 years			
MEI Dose (mg/m ³)	7.4×10^{-10}	NA	NA	NA
Noninvolved Worker (640 m) Dose (mg/m ³)	2.2×10^{-8}	NA	NA	NA
TPB Tank Spill – Frequency:	Once in 30 years			
MEI Dose (mg/m ³)	0.060	NA	NA	NA
Noninvolved Worker (640 m) Dose (mg/m ³)	18.7	NA	NA	NA
Organic Evaporator Loss of Confinement – Frequency:	Once in 30 years			
MEI Dose (mg/m ³)	0.45	NA	NA	NA
Noninvolved Worker (640 m) Dose (mg/m ³)	130	NA	NA	NA
Beyond Design Basis Earthquake – Frequency:	Less than once in 2,000 years			
MEI Dose (mg/m ³)	0.0026	NA	NA	NA
Noninvolved Worker (640 m) Dose (mg/m ³)	0.78	NA	NA	NA
OWST Loss of Confinement – Frequency:	Once in 140,000 years			
MEI Dose (mg/m ³)	3.2	NA	NA	NA
Noninvolved Worker (640 m) Dose (mg/m ³)	950 ^b	NA	NA	NA
Loss of Cooling – Frequency:	Once in 170,000 years			
MEI Dose (mg/m ³)	0.0015	NA	NA	NA
Noninvolved Worker (640 m) Dose (mg/m ³)	0.44	NA	NA	NA
Benzene Explosion in the OWST – Frequency:	Once in 770,000 years			
MEI Dose (mg/m ³)	30	NA	NA	NA
Noninvolved Worker (640 m) Dose (mg/m ³)	8,840 ^c	NA	NA	NA

- a. Individuals exposed to sodium hydroxide concentrations above 0.5 mg/m³ could experience mild transient health effects (e.g., rash, headache, nausea) or perception of a clearly defined objectionable odor.
- b. Individuals exposed to benzene concentrations above 480 mg/m³ could experience or develop irreversible or other serious health effects (e.g., dizziness, confusion, impaired vision).
- c. Individuals exposed to benzene concentrations above 3,190 mg/m³ could experience or develop life-threatening health effects (e.g., loss of consciousness, cardiac dysrhythmia, respiratory failure).
- NA = Not Applicable, MEI - maximally exposed (offsite) individual, PHA = precipitate hydrolysis aqueous, OWST = Organic Waste Storage Tank, TPB = tetraphenylborate.

Table 4-22. Estimated accident consequences for the Small Tank Precipitation process.

	Loss of Confinement - PHA surge tank ^a	Beyond Design-Basis Earthquake ^b	Fire in a Process Cell- PHA Surge tank ^a	Benzene explosion	Helicopter Impact - PHA Surge Tank ^a	Aircraft Impact ^b
Frequency	Once in 30 years	Less than once in 2,000 years	Once in 10,000 years	Once in 99,000 years	Once in 2,100,000 years	Once in 2,700,000 years
MEI dose (rem)	0.0016	0.31	0.014	0.70	3.3	5.4
MEI LCF per accident ^c	8.2×10^{-7}	1.5×10^{-4}	7.2×10^{-6}	3.5×10^{-4}	0.0016	0.0027
MEI LCF per year ^c	2.8×10^{-8}	7.6×10^{-8}	7.2×10^{-10}	3.5×10^{-9}	7.9×10^{-10}	1.0×10^{-9}
Offsite population dose (person-rem)	88	16,000	780	38,000	170,000	280,000
Offsite population LCF per accident	0.044	8.0	0.39	19	87	140
Offsite population LCF per year	0.0015	0.0040	3.9×10^{-5}	1.9×10^{-4}	4.2×10^{-5}	5.3×10^{-5}
Noninvolved worker Dose (rem)	0.024	9.6	0.21	10	100	170
Noninvolved worker LCF per accident ^c	9.5×10^{-6}	0.0038	8.5×10^{-5}	0.0041	0.041	0.067
Noninvolved worker LCF per year ^c	3.2×10^{-7}	1.9×10^{-6}	8.5×10^{-9}	4.1×10^{-8}	2.0×10^{-8}	2.5×10^{-8}
Involved worker dose (rem)	3.2×10^{-6}	310 ^d	2.8×10^{-5}	0.0014	3,300 ^d	5,400 ^d
Involved worker LCF per accident ^c	1.3×10^{-9}	0.12	1.1×10^{-8}	5.5×10^{-7}	1.3	2.1
Involved worker LCF per year ^c	4.3×10^{-11}	6.1×10^{-5}	1.1×10^{-12}	5.6×10^{-12}	6.3×10^{-7}	8.0×10^{-7}
Onsite population dose (person-rem)	39	9,000	340	17,000	97,000	160,000
Onsite population LCF per accident	0.016	3.6	0.14	6.7	39	63
Onsite population LCF per year	5.3×10^{-4}	0.0018	1.4×10^{-5}	6.8×10^{-5}	1.9×10^{-5}	2.3×10^{-5}

a. Tank/cell listed is bounding case (e.g., it results in the greatest impacts to offsite receptors and noninvolved workers).

b. Accident involves the entire facility.

c. Increased probability of an LCF to the exposed individual.

d. An acute dose to an individual over 300 rem would likely result in death.

PHA = precipitate hydrolysis aqueous; PHC = precipitate hydrolysis cell; MEI = maximally exposed offsite individual;
LCF = latent cancer fatality.

Table 4-23. Estimated accident consequences for the Ion Exchange process.

Frequency	Loss of Con- finement - Alpha Filter Cell ^a	Beyond Design-Basis Earthquake ^b	Loss of Cooling- Loaded Resin Hold Tank ^a	Fire in a Pro- cess Cell - Alpha Filter Cell ^a	Helicopter Impact - Alpha Fil- ter Cell ^a	Aircraft impact ^b
	Once in 30 years	Less than once in 2,000 years	Once in 5,300 years	Once in 10,000 years	Once in 2,100,000 years	Once in 2,700,000 years
MEI Dose (rem)	8.3×10^{-4}	0.12	9.4×10^{-7}	0.0094	1.7	2.0
MEI LCF per acci- dent ^c	4.2×10^{-7}	5.9×10^{-5}	4.7×10^{-10}	4.7×10^{-6}	8.5×10^{-4}	0.0010
MEI LCF per year ^c	1.4×10^{-8}	2.9×10^{-8}	8.9×10^{-14}	4.7×10^{-10}	4.1×10^{-10}	3.7×10^{-10}
Offsite population Dose (person-rem)	45	6,200	0.052	500	89,000	110,000
Offsite population LCF per accident	0.022	3.1	2.6×10^{-5}	0.25	45	53
Offsite population LCF per year	7.6×10^{-4}	0.0016	5.0×10^{-9}	2.5×10^{-5}	2.1×10^{-5}	2.0×10^{-5}
Noninvolved Worker Dose (rem)	0.012	3.7	1.4×10^{-5}	0.14	53	63
Noninvolved Worker LCF per accident ^c	4.9×10^{-6}	0.0015	5.7×10^{-9}	5.5×10^{-5}	0.021	0.025
Noninvolved Worker LCF per year ^c	1.6×10^{-7}	7.4×10^{-7}	1.1×10^{-12}	5.5×10^{-9}	1.0×10^{-8}	9.4×10^{-9}
Involved Worker Dose (rem)	6.4×10^{-8}	120	8.8×10^{-8}	9.1×10^{-7}	1,700 ^d	2,000 ^d
Involved Worker LCF per accident ^c	2.6×10^{-11}	0.047	3.5×10^{-11}	3.6×10^{-10}	0.68	0.81
Involved Worker LCF per year ^c	8.7×10^{-13}	2.4×10^{-5}	6.7×10^{-15}	3.6×10^{-14}	3.2×10^{-7}	3.0×10^{-7}
Onsite population Dose (person-rem)	20	3,500	0.023	220	50,000	59,000
Onsite population LCF per accident	0.0080	1.4	9.0×10^{-6}	0.089	20	24
Onsite population LCF per year	2.7×10^{-4}	6.9×10^{-4}	1.7×10^{-9}	8.9×10^{-6}	9.5×10^{-6}	8.8×10^{-6}

a. Tank/cell listed is bounding case (e.g., it results in the greatest impacts to offsite receptors and noninvolved workers).

b. Accident involves the entire facility.

c. Increased probability of an LCF to the exposed individual.

d. An acute dose to an individual over 300 rem would likely result in death.

MEI = maximally exposed offsite individual; LCF = latent cancer fatality.

Table 4-24. Estimated accident consequences for the Solvent Extraction process.

Frequency	Loss of Confinement - SSRT ^a	Beyond Design-Basis Earthquake ^b	Fire in a Process Cell - Alpha Filter Cell ^a	Hydrogen Explosion-Extraction Cell ^a	Helicopter Impact - Alpha Filter Cell ^a	Aircraft impact ^b
	Once in 30 years	Less than once in 2,000 years	Once in 10,000 years	Once in 1,300,000 years	Once in 2,100,000 years	Once in 2,700,000 years
MEI Dose (rem)	8.3×10^{-4}	0.12	0.0094	0.0029	1.7	2.0
MEI LCF per accident ^c	4.2×10^{-7}	5.8×10^{-5}	4.7×10^{-6}	1.4×10^{-6}	8.5×10^{-4}	0.0010
MEI LCF per year ^c	1.4×10^{-8}	2.9×10^{-8}	4.7×10^{-10}	1.1×10^{-12}	4.1×10^{-10}	3.8×10^{-10}
Offsite population Dose (person-rem)	45	6,100	500	160	89,000	110,000
Offsite population LCF per accident	0.022	3.0	0.25	0.081	45	54
Offsite population LCF per year	7.6×10^{-4}	0.0015	2.5×10^{-5}	6.1×10^{-8}	2.1×10^{-5}	2.0×10^{-5}
Noninvolved Worker Dose (rem)	0.012	3.6	0.14	0.044	53	64
Noninvolved Worker LCF per accident ^c	4.9×10^{-6}	0.0015	5.5×10^{-5}	1.8×10^{-5}	0.021	0.026
Noninvolved Worker LCF per year ^c	1.6×10^{-7}	7.3×10^{-7}	5.5×10^{-9}	1.3×10^{-11}	1.0×10^{-8}	9.5×10^{-9}
Involved Worker Dose (rem)	6.4×10^{-8}	120	7.2×10^{-7}	2.7×10^{-4}	1,700 ^d	2,000 ^d
Involved Worker LCF per accident ^c	2.6×10^{-11}	0.046	2.9×10^{-10}	1.1×10^{-7}	0.68	0.81
Involved Worker LCF per year ^c	8.7×10^{-13}	2.3×10^{-5}	2.9×10^{-14}	8.1×10^{-14}	3.3×10^{-7}	3.0×10^{-7}
Onsite population Dose (person-rem)	20	3,400	220	70	50,000	60,000
Onsite population LCF per accident	0.0080	1.4	0.089	0.028	20	24
Onsite population LCF per year	2.7×10^{-4}	6.8×10^{-4}	8.9×10^{-6}	2.1×10^{-8}	9.6×10^{-6}	8.9×10^{-6}

a. Tank/cell listed is bounding case (e.g., it results in the greatest impacts to offsite receptors and noninvolved workers).

b. Accident involves the entire facility.

c. Increased probability of an LCF to the exposed individual.

d. An acute dose to an individual over 300 rem would likely result in death.

SSRT = sludge solids receipt tank; MEI = maximally exposed offsite individual; LCF = latent cancer fatality.

Table 4-25. Estimated accident consequences for the Direct Disposal in Grout process.

	Loss of Confinement - SSRT ^a	Beyond Design- Basis Earthquake ^b	Fire in a Process Cell - SSRT ^a	Helicopter Impact - SSRT ^a	Aircraft impact ^b
Frequency	Once in 30 years	Less than once in 2,000 years	Once in 10,000 years	Once in 2,100,000 years	Once in 2,700,000 years
MEI Dose (rem)	2.4×10^{-4}	0.042	0.0027	0.53	0.74
MEI LCF per accident ^c	1.2×10^{-7}	2.1×10^{-5}	1.4×10^{-6}	2.7×10^{-4}	3.7×10^{-4}
MEI LCF per year ^c	4.1×10^{-9}	1.0×10^{-8}	1.4×10^{-10}	1.3×10^{-10}	1.4×10^{-10}
Offsite population Dose (person-rem)	14	2,300	160	29,000	40,000
Offsite population LCF per accident	0.0072	1.1	0.081	14	19
Offsite population LCF per year	2.4×10^{-4}	5.7×10^{-4}	8.1×10^{-6}	6.9×10^{-6}	7.4×10^{-6}
Noninvolved Worker Dose (rem)	0.0036	1.3	0.041	17	23
Noninvolved Worker LCF per accident ^c	1.5×10^{-6}	5.3×10^{-4}	1.6×10^{-5}	0.0067	0.0093
Noninvolved Worker LCF per year ^c	4.9×10^{-8}	2.6×10^{-7}	1.6×10^{-9}	3.2×10^{-9}	3.4×10^{-9}
Involved Worker Dose (rem)	7.3×10^{-8}	42	8.2×10^{-7}	53	740 ^d
Involved Worker LCF per accident ^c	2.9×10^{-11}	0.017	3.3×10^{-10}	0.21	0.30
Involved Worker LCF per year ^c	9.8×10^{-13}	8.4×10^{-6}	3.3×10^{-14}	1.0×10^{-7}	1.1×10^{-7}
Onsite population Dose (person-rem)	42	1,000	48	13,000	18,000
Onsite population LCF per accident	0.0017	0.41	0.19	5.3	7.3
Onsite population LCF per year	5.7×10^{-5}	2.1×10^{-4}	1.9×10^{-6}	2.5×10^{-6}	2.7×10^{-6}

a. Tank/cell listed is bounding case (e.g., results in the greatest impacts to offsite receptors and noninvolved workers).

b. Accident involves the entire facility.

c. Increased probability of an LCF to the exposed individual.

d. An acute dose to an individual over 300 rem would likely result in death.

SSRT = sludge solids receipt tank; MEI = maximally exposed offsite individual; LCF = latent cancer fatality.

(1999) and estimated impacts using the AXAIRQ computer model (Simpkins 1995a,b), as discussed in Appendix B.

4.1.14 PILOT PLANT

As discussed in Section 2.7.6, a Pilot Plant would be designed and constructed to dem-

onstrate the overall process objectives of the salt processing alternative that DOE will select. Details of the proposed demonstration objectives are provided in Appendix A. Detailed design and construction of the Pilot Plant would be initiated upon selection of the salt processing alternative and operation would extend through completion of final design and potentially

through startup of the full-scale facility. This section discusses potential impacts from construction and operation of the Pilot Plant for each salt processing action alternative.

For the purposes of this SEIS, DOE assumes that the Pilot Plant components would be sized to operate on a scale of approximately 1/100 to 1/10 that of the full-size facility, and would utilize a modular design to facilitate remote installation and modification of the process equipment. A Pilot Plant for the Direct Disposal in Grout alternative is not planned because this technology is better developed than the other action alternatives, and has been demonstrated at full scale in the Saltstone Manufacturing and Disposal Facility. Therefore, this SEIS does not include a demonstration of the Direct Disposal in Grout alternative.

DOE intends to construct and operate a Pilot Plant only for the selected alternative. Knowledge gained from the demonstration could lead to a decision to demonstrate more than one salt processing alternative technology. In the event that DOE decides to demonstrate more than one technology, the Pilot Plant units would be developed and operated in series. Therefore, impacts associated with more than one Pilot Plant would not occur at the same time, but would extend over a longer period.

The Pilot Plant would be designed to demonstrate the processing of real radioactive wastes. Principal process operations would be conducted inside shielded cells.

The Pilot Plant would be located in an existing process area well within the SRS boundary. Candidate sites include the Late Wash Facility in H Area (see Figure 2-3), which was designed and built to handle radiological operations and is located near DWPF, in S Area or in another area similar to the location of the proposed full-scale facility.

Services to support operations would be provided, including utilities, process chemicals, ventilation systems, and habitability services. An appropriate chemical storage area would be developed, with isolation of acids, caustics, oxidizing and reducing agents, and other incompatible reactants. Ventilation systems would be operated such that airflow is from regions of low contamination to areas of higher contamination.

The generation and dispersion of radioactive and hazardous materials would be minimized. Process waste would be managed at appropriate site locations, such as DWPF, Saltstone Manufacturing and Disposal Facility, HLW Tank Farms and the LLW vaults.

All Pilot Plants are at the pre-conceptual stage, therefore, the analysis in this section is qualitative.

4.1.14.1 Geologic Resources

The Pilot Plant would be constructed in an existing facility in a previously disturbed area. Therefore, no additional impact to geologic resources would occur.

4.1.14.2 Water Resources

The Pilot Plant would be constructed in an existing facility. No additional land would be disturbed therefore the water table would not be disturbed and no increase in suspended solids in stormwater runoff would be expected. Therefore, no impact to surface water or groundwater resources would occur during construction.

The Pilot Plant would generate less than 10 percent of the sanitary and process wastewater of the full size salt processing facility on an annual basis. DOE concluded in Section 4.1.2 that regardless of the alternative selected, impacts to surface water as a result of salt processing facility activities would be minimal and there would be no impact to groundwater quality. The quantity of sanitary and process wastewater generated by the Pilot Plant would be much smaller than the amount generated by the salt processing

facility, therefore surface water impacts from operation of the Pilot Plant would be minimal and there would be no impact to groundwater quality.

4.1.14.3 Air Resources

The Pilot Plant would use skid-mounted equipment and be constructed in an existing facility. No land would be disturbed during construction, therefore the use of heavy-duty construction equipment (i.e., trucks, bulldozers, and other diesel-powered support equipment) would be minimized. Therefore, impacts to air quality during construction would be minimal.

As shown in Table 4-7, with the exception of VOCs, the nonradiological air emissions from the full-scale salt processing facility for each alternative are similar and would be well below the SCDHEC PSD limit. The estimated VOC emissions for the full-scale Ion Exchange facility would not be greater than 5 percent of the PSD limit of 40 tons per year. The estimated VOC emissions for the full-scale Small Tank Precipitation facility would be 70 tons per year, while the emissions from the full-scale Solvent Extraction facility would be 40 tons per year. VOC emissions from both full-scale facilities would exceed the PSD limit of 40 tons per year. Because air emissions from the Pilot Plant would not be greater than 10 percent of the emissions from the full-size facility, all nonradiological emissions from the Pilot Plant would be much lower than their corresponding PSD limits. Similarly, incremental increases in air concentrations at the SRS boundary would also be much lower than those projected for the full-scale facility.

As shown in Table 4-8, all radiological air emissions from the full-scale facility for each alternative would be similar and low. Because air emissions from the Pilot Plant would not be greater than 10 percent of the emissions from the full-size facility, incremental impacts of radiological emissions from the Pilot Plant would be minimal.

4.1.14.4 Worker and Public Health

In Section 4.1.4 DOE concluded the overall occupational and health impacts (radiological, non-radiological, and occupational safety) would be minimal for the full-scale Small Tank Precipitation, Ion Exchange, Solvent Extraction, and Direct Disposal in Grout facilities. Doses to the noninvolved worker would be well below Federal limits and SRS administrative guides and would not result in adverse impacts. Exposures to the MEI would result in an annual dose that is below the Federal exposure limits. The Pilot Plant would not be greater than 1/10 the size of the preferred salt processing alternative and would be operated in a manner that minimizes the generation and dispersion of radioactive and hazardous materials. Therefore, the overall occupational and health impacts (radiological, non-radiological, and occupational safety) would be similar and minimal.

4.1.14.5 Environmental Justice

In Section 4.1.5, DOE concluded that the potential offsite consequences to the general public of the proposed action and the alternatives would be small, and there would be no disproportionately high and adverse impacts to minority or low-income populations. The Pilot Plant would not be greater than 1/10 the size of the preferred salt processing alternative and would be operated in a manner that minimizes the generation and dispersion of radioactive and hazardous materials. Therefore, by similarity, the Pilot Plant would have no disproportionately high and adverse impacts to minority or low-income populations.

4.1.14.6 Ecological Resources

The Pilot Plant would be constructed in an existing facility located in a heavily industrialized area that has marginal value as wildlife habitat. Construction would involve the movement of workers and construction equipment, but no earth-moving equipment would be anticipated, so noise levels would be somewhat lower than the levels that would be experienced during construction of the full-scale facility. Construction-

related disturbances are likely to create impacts to wildlife that would be small, intermittent, and localized.

Operation of the Pilot Plant would entail movement of workers and equipment and noise from public address systems (e.g., testing of radiation and fire alarms), air compressors, pumps, and HVAC-related equipment. With the possible exception of the public address systems, noise levels generated by these kinds of sources are not expected to disturb wildlife outside of facility boundaries.

4.1.14.7 Land Use

The Pilot Plant would be constructed in an existing facility located in an area designated for industrial use. Therefore, no change in land use patterns would occur.

4.1.14.8 Socioeconomics

The Pilot Plant would be constructed in an existing facility. During construction of the Pilot Plant, the number of workers would be restricted by space constraints inside the proposed facility. In addition, the Pilot Plant would have a modular design that maximizes the use of skid-mounted equipment, which would facilitate remote installation and further limit the number of workers required for construction. Therefore, the number of workers involved in the construction of the Pilot Plant would be much lower than the number of workers required for construction of the salt processing facility.

The Small Tank Precipitation process facility would require approximately 180 operations employees. The Ion Exchange process facility would require approximately 135 operations employees. The Solvent Extraction process facility would require approximately 220 operations employees, (WSRC 1998a, 2000a). These same employees would be trained in and would operate the Pilot Plant.

4.1.14.9 Cultural Resources

The Pilot Plant would be constructed in an existing facility and would, therefore, not disturb any cultural or historic resources. Therefore, no impact to cultural resources would occur.

4.1.14.10 Traffic and Transportation

In Section 4.1.10, DOE estimated that material shipments required for implementation of the alternatives would result in 403,000 to 529,000 miles traveled over the 13 year life of the facility and no accidents involving injuries or fatalities would be expected during those material shipments. The Pilot Plant would operate potentially for a period of approximately 5.5 years and the number of material shipments would be substantially lower, so no accidents involving injuries or fatalities would be expected during material shipments to the Pilot Plant.

During the life of the Pilot Plant, workers would make between 184,250 and 292,000 Site trips. Under the Small Tank Precipitation Pilot Plant, workers would make approximately 240,000 Site trips; 45 accidents, 20 injuries and no fatalities would be expected. Under the Ion Exchange Pilot Plant, workers would make approximately 184,250 Site trips; 35 accidents, 15 injuries and no fatalities would be expected. Under the Solvent Extraction Pilot Plant, workers would make approximately 292,000 Site trips; 55 accidents, 24 injuries and no fatalities would be expected.

4.1.14.11 Waste Generation

The Pilot Plant would generate no greater than 10 percent of the waste of the full-size salt processing facility on an annual basis. Waste generation under the Solvent Extraction Pilot Plant would be slightly higher than the other Pilot Plant units, due to the inclusion of a 1/5-scale centrifugal contactor.

As with the full-scale salt processing facility, the Pilot Plant would generate minimal quantities of low-level, transuranic, hazardous, industrial, and sanitary waste under all scenarios. All opera-

tions would generate a small amount of radioactive liquid waste, but the quantity generated by the Solvent Extraction Pilot Plant would be somewhat higher than that generated by the other three Pilot Plants. The Ion Exchange Pilot Plant would generate a small amount of nonradioactive liquid waste, while the Pilot Plants for the other two action alternatives would generate minute quantities of nonradioactive liquid waste. All Pilot Plant operations would generate a small amount of mixed LLW, but the quantity generated by the Solvent Extraction Pilot Plant would be higher than that generated by the Small Tank Precipitation and Ion Exchange Pilot Plants. Because it produces a comparatively large amount of benzene, the Small Tank Precipitation Pilot Plant would generate considerably more mixed low-level liquid waste than the other two Pilot Plants.

4.1.14.12 Utilities and Energy

Utility and energy use during construction of the Pilot Plant would be minimal. No steam would be used, and the use of skid-mounted equipment and the fact that the Pilot Plant would be constructed in an existing facility would limit water, electricity, and fuel requirements.

Utility and energy use during operation of the Pilot Plant would not be greater than 10 percent of the amount used in the full-size salt processing facility on an annual basis. Utility and energy demand for the Solvent Extraction Pilot Plant would be slightly higher than the other Pilot Plants due to the inclusion of a 1/5-scale centrifugal contactor. The impact to SRS utility and energy supplies would be minimal during operation of the Pilot Plant.

4.2 Long-Term Impacts

This section presents estimates of long-term impacts of the four salt processing action alternatives and the No Action alternatives. For all the action alternatives, the major source of long-term impacts would be the saltstone that would result from each of the

four alternatives. As discussed in Chapter 2, the saltstone vaults would be located in Z Area, regardless of the selected alternative. Therefore, this SEIS analyzes impacts only from the placement of saltstone in Z Area. Short-term impacts of manufacturing the saltstone are included in Section 4.1.

For NEPA analysis of long-term impacts of the action alternatives, DOE assumed that institutional control would be maintained for 100 years post-closure, during which the land encompassing the saltstone vaults would be managed to prevent erosion or other conditions that would lead to early degradation of the vaults. DOE also assumed that the public would not have access to Z Area during this time to set up residence. DOE estimated long-term impacts by doing a performance evaluation that included fate and transport modeling to determine when certain impacts (e.g., radiation dose) could peak. DOE used the *Radiological Performance Assessment for the Z-Area Saltstone Disposal Facility* (WSRC 1992) (RPA) as the basis for the water resources and human health analyses. This performance assessment was done for the original saltstone that would have resulted from the In-Tank Precipitation process. For this SEIS, DOE modified the source terms for each of the action alternatives. See Appendix D for details of the analysis.

For NEPA analysis of long-term impacts of the No Action alternative, DOE assumes that the sludge in the HLW tanks would be processed to the extent practicable so that only salt waste would be left in the tanks, and the tanks would be nearly full. It is also assumed that DOE would take no further action to stabilize the waste remaining in the tanks or to stabilize the tank systems themselves, but would maintain institutional control and would maintain the tanks for 100 years. Following this 100-year period of institutional control, the HLW tanks would begin to fail. Failed tanks could create physical hazards to humans and wildlife in the area. Waste contaminants could be released from tanks into groundwater and the contaminants would eventually migrate to surface water. Precipitation could infiltrate into failed tanks, causing them to overflow and spill dissolved salt

L3-1
L6-4
L7-3
L8-5
L8-6

onto the ground surface. Salt solutions spilled onto the ground surface could contaminate the soil, vegetation, and groundwater, and could flow overland to surface streams (Upper Three Runs, Fourmile Branch, and the Savannah River). People who intruded into the site vicinity could receive radiation exposure by external exposure to contaminated soil or by consuming contaminated surface water, groundwater, or vegetation, or eating meat or dairy products from animals that had consumed such water or vegetation.

In the Draft SEIS, DOE did not model the eventual release of salt waste to the environment under the No Action alternative. Instead, DOE provided a comparison to the modeling results from the No Action alternative in the *High-Level Waste Tank Closure Draft Environmental Impact Statement* (DOE 2000). In the Tank Closure Draft EIS No Action scenario, most of the waste would be removed from the HLW tanks (i.e., approximately 10,000 gallons would remain as residual waste in a 1.3-million-gallon tank). After a period of several hundred years, the remaining waste, 200 curies of long half-life isotopes and 9,900 curies of cesium-137 (which has a relatively short half-life of 30 years), would be released to groundwater and eventually migrate to surface water. The Tank Closure Draft EIS modeling showed that an adult resident in the F-Area Tank Farm could receive a lifetime dose of 430 millirem (primarily from groundwater) and incur an incremental risk of 0.0022 of contracting a fatal cancer. For comparison, in the No Action alternative in the Salt Processing Alternatives Draft SEIS, DOE assumed that HLW would be left in the tanks and the tanks would be nearly full and that 160,000,000 curies (primarily cesium-137) in the salt component and 290,000,000 curies (primarily long half-life isotopes) in the sludge component of the HLW in the storage tanks would be released to groundwater and eventually enter surface water. This analysis did not take credit for any decay of the short half-life radionuclides, particularly cesium-137. Because the

activity under this scenario (450,000,000 curies) would be much greater than the activity (10,000 curies) modeled in the Tank Closure Draft EIS, the Salt Processing Alternatives Draft SEIS stated that long-term impacts to human health resulting from the radiation dose under the No Action alternative would be catastrophic.

During the public comment period, DOE received several comments from the public (See Appendix C, Letters L3, L6, L7, and L8) questioning the description of the No Action alternative and its impacts. The commenters generally expressed the opinion that the long-term impacts of No Action would be more severe than portrayed qualitatively in the Salt Processing Alternatives Draft SEIS and requested that the No Action alternative be modified and the long-term impacts analyzed quantitatively. One commenter suggested that, to be consistent with the short-term No Action scenario described in Section 2.3, the long-term No Action scenario should contain the consequences of removing all the sludge and leaving the salt waste containing 160,000,000 curies of activity (primarily cesium-137) in the tanks. In addition, several commenters suggested that, by assuming all radionuclides would reach the public through groundwater, the Salt Processing Alternatives Draft SEIS missed the largest long-term risk to the public and that DOE should consider the release of HLW to surface run-off.

In response to these comments, for this Final Salt Processing Alternatives SEIS, DOE modeled the potential impacts of a scenario in which precipitation leaks into the tanks, causing them to overflow and spill their contents onto the ground surface, from which contaminants migrate to surface streams.

DOE estimated that the salt waste in the HLW tanks now contains about 160,000,000 curies, approximately 500 curies of long half-life isotopes (e.g., technetium-99, iodine-129, and plutonium-239), and the balance short half-life isotopes, primarily cesium-137, which has a half-life of 30 years. Radioactive decay during the 100-year period of institutional control would reduce the activity level to around 16,000,000 curies.

L3-2
L6-4
L7-3
L8-5
L8-6

L3-2
L6-4
L7-3
L8-5
L8-6

L6-3
L6-5

To conservatively estimate the consequences of this scenario for water users, DOE modeled the eventual release of the salt waste to surface water at SRS, assuming no loss of contaminants during overland flow. The modeling showed that an individual consuming 2 liters per day of water from Four-mile Branch would receive a dose of 640 millirem per year. This dose is more than 160 times the drinking water regulatory limit of 4 millirem per year and would result in a 2.2 percent increase in the probability of contracting a latent cancer fatality from a 70-year lifetime exposure. When a 2.2 percent increase is low, the probability of contracting a latent cancer fatality under the No Action alternative is about 13,000 times greater than that of any of the action alternatives. Similarly, an individual consuming the same amount of water from Upper Three Runs would receive a dose of 295 millirem per year, and an individual consuming the same amount of water from the Savannah River would receive a dose of 14.5 millirem per year. These doses also exceed the drinking water limit and would incrementally increase the probability of contracting a latent cancer fatality from a 70-year lifetime exposure by 1.0 percent and 0.051 percent, respectively.

For the No Action alternative, DOE also considered potential external radiation exposure from the tank overflow scenario described above for a resident in the tank farm area, conservatively assuming that all contamination is deposited on the ground surface rather than flowing to streams or entering the underlying soil. The modeling showed that an individual living in the tank farm would receive an external dose of about 2,320 rem in the first year following the event, which would result in a prompt fatality.

DOE expects that those two scenarios bound the potential impacts of the No Action alternative. This is consistent with results of a multipathway exposure analysis for the

Z-Area vaults, which showed that the external radiation dose an individual would receive from cesium-137 is considerably greater than doses an individual would receive from other exposure pathways (e.g., drinking water).

Because of the assumption that, in the long term, DOE would not be active at the Site, there would be no long-term impacts to socioeconomics, utilities and energy, worker health, traffic and transportation, or waste generation. Air and accident impacts would be very small and would not differ substantially among alternatives. Section 4.2 does not analyze or discuss long-term impacts to these resources. The following impact areas are analyzed: geologic resources, water resources (groundwater and surface water), ecological resources, land use, and public health.

4.2.1 GEOLOGIC RESOURCES

The Small Tank Precipitation, Ion Exchange, Solvent Extraction, and Direct Disposal in Grout alternatives include disposal of radioactive waste in vaults in Z Area. Failure of the vaults at some time in the future would have the potential to contaminate the surrounding soils. If the integrity of a vault were breached, infiltration of water could result in contaminants leaching to groundwater. The water-borne contaminants would contaminate nearby soils, but would not alter their physical structure. No detrimental effect on surface soils, topography, or on the structural or load-bearing properties of geologic deposits would occur because of release of contaminants from the vaults.

Under the No Action alternative, DOE assumed that only salt waste would be left in the HLW tanks. Failure of the HLW tanks would allow precipitation to collect in the tanks and eventually salt solution could overflow and contaminate surface soils. No detrimental effect on topography or load-bearing properties of geologic deposits would result from release of contaminants from the HLW tanks.

L6-3
L6-5

L6-60